

CLAIMS

1 1. (currently amended) A method of selecting one of a plurality of queues for service, at
2 least one of the plurality of queues associated with a first traffic class, the method comprising the steps
3 of:

4 (a) identifying each first traffic class (FTC) queue having at least one enqueued cell as an
5 occupied FTC queue wherein at least one FTC queue is provisioned for burst scheduling of multiple cells
6 when serviced;

7 (b) identifying an occupied FTC queue provisioned for burst scheduling as a super-occupied
8 FTC queue when the number of cells enqueued is greater than a specified number;

9 (c) setting as eligible for service each occupied FTC queue based on a FTC scheduling
10 algorithm, wherein, for step (c), the FTC scheduling algorithm is a shaped virtual clock algorithm; and

11 (d) selecting for service an eligible FTC queue based on a corresponding sub-priority of
12 each eligible FTC queue, wherein:

13 each FTC queue is assigned a sub-priority based on a service level of a connection associated
14 with enqueued cells; and

15 when the super-occupied queue is serviced, the number of cells dequeued is based on a burst
16 size.

1 2. (original) The invention of claim 1, wherein, for step (a) the first traffic class comprises
2 traffic having a provisioned guaranteed level of service.

1 3. (canceled)

1 4. (original) The invention of claim 1, wherein step (a) comprises the steps of:

2 (a1) identifying whether a queue having cells associated with unicast traffic is occupied; and
3 (a2) identifying whether a queue having cells associated with multicast traffic is occupied.

1 5. (canceled)

1 6. (currently amended) The invention of claim [[5]] 1, wherein, for step (c), each FTC
2 queue has a corresponding down counter and service period value, wherein step (c) further comprises the
3 steps of, during a scheduling interval, counting down from the service period value to a predefined value,
4 and setting the corresponding FTC queue as eligible when the down counter reaches the predefined
5 value.

1 7. (original) The invention of claim 6, wherein step (c) further comprises the step of
2 continuing to count from the predefined value to generate a service delay value, and for a subsequent
3 scheduling interval adjusting the service period value based on the service delay value.

1 8. (original) The invention of claim 1, wherein step (c) further comprises the step of
2 further setting an occupied FTC queue as eligible based on congestion information.

1 9. (previously presented) The invention of claim 1, wherein step (d) comprises the step of,
2 for each sub-priority, addressing with a pointer the FTC queue having the highest priority value within
3 those eligible FTC queues assigned to the sub-priority, the sub-priority of an eligible FTC queue based
4 on the order in which the eligible FTC queue is set as eligible.

1 10. (original) The invention of claim 9, further comprising the steps of: ranking each
2 sub-priority, selecting the FTC queue within a sub-queue based on the pointer, and selecting for service
3 the selected FTC queue from among the sub-queues based on the corresponding sub-queue's rank.

1 11. (original) The invention of claim 9, further comprising the steps of generating a bid
2 when the FTC queue selector selects a given FTC queue for service, and servicing the given FTC queue
3 when the bid is granted.

1 12. (previously presented) The invention of claim 1, wherein at least one of the plurality of
2 queues is associated with a second traffic class (STC), step (a) further comprises the step of identifying
3 each STC queue having at least one enqueued cell as an occupied STC queue, and the method further
4 comprises the steps of:

- 5 (e) setting as eligible for service each occupied STC queue based on a STC scheduling
6 algorithm;
- 7 (f) selecting for service an eligible STC queue based on the corresponding priority of the
8 eligible STC queue; and
- 9 (g) selecting one of the FTC queue selected for service, if present, and the STC queue
10 selected for service, if present.

1 13. (original) The invention of claim 12, further comprising the steps of assigning each FTC
2 queue priority over each STC queue, and selecting either the FTC queue or the STC queue based on the
3 assigned priority.

1 14. (original) The invention of claim 12, wherein, for step (e), the STC scheduling
2 algorithm is a weighted round robin scheduling algorithm.

1 15. (original) The invention of claim 12, wherein step (e) includes the step of accounting for
2 delay in service of each eligible STC queue.

1 16. (original) The invention of claim 12, for step (e), the second traffic class is best effort
2 traffic.

1 17. (original) The invention of claim 1, wherein the method is embodied as program steps in
2 a processor of an integrated circuit.

1 18. (currently amended) A scheduler for selecting one of a plurality of queues for service, at
2 least one of the plurality of queues associated with a first traffic class (FTC), the scheduler comprising:

3 an occupancy processor configured to identify each FTC queue having at least one enqueued cell
4 as an occupied FTC queue, wherein:

5 1) at least one FTC queue may be provisioned for burst scheduling of multiple cells
6 when serviced, and

7 2) an occupied FTC queue provisioned for burst scheduling is also identified as a
8 super-occupied FTC queue when a number of cells enqueued is greater than a provisioned number;

9 a FTC eligibility processor configured to set as eligible for service each occupied FTC queue
10 based on a FTC scheduling algorithm, wherein the FTC scheduling algorithm is a shaped virtual clock
11 algorithm; and

12 a FTC queue selector configured to select for service an eligible FTC queue,

13 wherein each FTC queue is assigned a sub-priority based on a service level of a connection
14 associated with enqueued cells, the FTC queue selector selects an eligible FTC queue based on the

15 corresponding sub-priority of each eligible FTC queue, and when the super-occupied FTC queue is
16 serviced, the number of cells dequeued is based on a burst size.

1 19. (original) The invention of claim 18, wherein the first traffic class comprises traffic
2 having a provisioned guaranteed level of service.

1 20. (canceled)

1 21. (original) The invention of claim 18, wherein the occupancy processor comprises:
2 a unicast occupancy processor configured to identify whether a queue having cells associated
3 with unicast traffic is occupied; and
4 a multicast occupancy processor configured to identify whether a queue having cells associated
5 with multicast traffic is occupied.

1 22. (canceled)

1 23. (currently amended) The invention of claim [[22]] 18, wherein the FTC eligibility
2 processor comprises a plurality of down counters, each FTC queue having a corresponding down counter
3 and service period value, wherein during a scheduling interval each down counter counts from the
4 service period value to a predefined value, and the corresponding FTC queue is set as eligible when the
5 down counter reaches the predefined value.

1 24. (original) The invention of claim 23, wherein, the down counter continues to count from
2 the predefined value to generate a service delay value, wherein for a subsequent scheduling interval the
3 service period value is adjusted based on the service delay value.

1 25. (original) The invention of claim 18, wherein the FTC eligibility processor receives
2 output port congestion information, and the FTC eligibility processor sets an occupied FTC queue as
3 eligible based on the congestion information.

1 26. (previously presented) The invention of claim 18, wherein, for each sub-priority, the
2 FTC queue selector comprises a pointer addressing the FTC queue having the highest priority value
3 within those eligible FTC queues assigned to the sub-priority, the priority of an eligible FTC queue based
4 on the order in which the eligible FTC queue is set as eligible by the FTC eligibility processor.

1 27. (original) The invention of claim 26, wherein each sub-priority is ranked, and the FTC
2 queue selector selects the FTC queue within a sub-queue based on the pointer, and selects for service the
3 selected FTC queue from among the sub-queues based on the corresponding sub-queue's rank.

1 28. (original) The invention of claim 26, wherein, when the FTC queue selector selects a
2 given FTC queue for service, a bid is generated and the given FTC queue is serviced when the bid is
3 granted.

1 29. (previously presented) The invention of claim 18, wherein at least one of the plurality of
2 queues is associated with a second traffic class (STC), the occupancy processor is configured to identify
3 each STC queue having at least one enqueued cell as an occupied STC queue, and the scheduler further
4 comprises:

5 a STC eligibility processor configured to set as eligible for service each occupied STC queue
6 based on a STC scheduling algorithm;

7 a STC queue selector configured to select for service an eligible STC queue based on the
8 corresponding priority of the eligible STC queue; and
9 a scheduler /arbiter controller configured to select one of the FTC queue selected for service, if
10 present, and the STC queue selected for service, if present.

1 30. (canceled)

1 31. (original) The invention of claim 29, wherein the STC scheduling algorithm is a
2 weighted round robin scheduling algorithm.

1 32-33. (canceled)

1 34. (original) The invention of claim 18, wherein the scheduler is embodied in a
2 telecommunications switch.

1 35. (original) The invention of claim 34, wherein the telecommunications switch is a three
2 stage switch, the plurality of queues are associated with connections received at a plurality of input ports
3 of the first stage, and the scheduler is embodied in the first stage to transfer cells to a plurality of input
4 links of the second stage.

1 36. (previously presented) The invention of claim 34, wherein the telecommunications
2 switch is a three stage switch, the plurality of queues are associated with cells received from output links
3 of the second stage, and the scheduler is embodied in the third stage to transfer cells from the plurality of
4 queues to a plurality of output ports.

1 37. (original) The invention of claim 18, wherein the scheduler is embodied in an integrated
2 circuit.

1 38. (currently amended) A computer-readable medium having stored thereon a plurality of
2 instructions, the plurality of instructions including instructions which, when executed by a processor,
3 cause the processor to implement a method of selecting one of a plurality of queues for service, at least
4 one of the plurality of queues associated with a first traffic class, the method comprising the steps of:

5 (a) identifying each first traffic class (FTC) queue having at least one enqueued cell as an
6 occupied FTC queue wherein at least one FTC queue is provisioned for burst scheduling of multiple cells
7 when serviced;

8 (b) identifying an occupied FTC queue provisioned for burst scheduling as a super-occupied
9 FTC queue when the number of cells enqueued is greater than a specified number;

10 (c) setting as eligible for service each occupied FTC queue based on a FTC scheduling
11 algorithm, wherein, for step (c), the FTC scheduling algorithm is a shaped virtual clock algorithm; and

12 (d) selecting for service an eligible FTC queue based on a corresponding sub-priority of
13 each eligible FTC queue, wherein:

14 each FTC queue is assigned a sub-priority based on a service level of a connection associated
15 with enqueued cells; and

16 when the super-occupied queue is serviced, the number of cells dequeued is based on a burst
17 size.

1 39. (previously presented) The invention of claim 1, wherein more than one cell is dequeued
2 from the super-occupied queue during a single selection of the super-occupied queue for service.

1 40. (previously presented) The invention of claim 18, wherein more than one cell is
2 dequeued from the super-occupied queue during a single selection of the super-occupied queue for
3 service.

1 41. (canceled)

1 42. (new) A method of selecting one of a plurality of queues for service, at least one of the
2 plurality of queues associated with a first traffic class, the method comprising the steps of:

3 (a) identifying each first traffic class (FTC) queue having at least one enqueued cell as an
4 occupied FTC queue wherein at least one FTC queue is provisioned for burst scheduling of multiple cells
5 when serviced;

6 (b) identifying an occupied FTC queue provisioned for burst scheduling as a super-occupied
7 FTC queue when the number of cells enqueued is greater than a specified number;

8 (c) setting as eligible for service each occupied FTC queue based on a FTC scheduling
9 algorithm; and

10 (d) selecting for service an eligible FTC queue based on a corresponding sub-priority of
11 each eligible FTC queue, wherein:

12 each FTC queue is assigned a sub-priority based on a service level of a connection associated
13 with enqueued cells;

14 when the super-occupied queue is serviced, the number of cells dequeued is based on a burst
15 size; and

16 step (d) comprises the step of, for each sub-priority, addressing with a pointer the FTC queue
17 having the highest priority value within those eligible FTC queues assigned to the sub-priority, the
18 sub-priority of an eligible FTC queue based on the order in which the eligible FTC queue is set as
19 eligible.

1 43. (new) The invention of claim 42, further comprising the steps of: ranking each
2 sub-priority, selecting the FTC queue within a sub-queue based on the pointer, and selecting for service
3 the selected FTC queue from among the sub-queues based on the corresponding sub-queue's rank.

1 44. (new) The invention of claim 42, further comprising the steps of generating a bid when
2 the FTC queue selector selects a given FTC queue for service, and servicing the given FTC queue when
3 the bid is granted.

1 45. (new) A method of selecting one of a plurality of queues for service, at least one of the
2 plurality of queues associated with a first traffic class, the method comprising the steps of:

3 (a) identifying each first traffic class (FTC) queue having at least one enqueued cell as an
4 occupied FTC queue wherein at least one FTC queue is provisioned for burst scheduling of multiple cells
5 when serviced;

6 (b) identifying an occupied FTC queue provisioned for burst scheduling as a super-occupied
7 FTC queue when the number of cells enqueued is greater than a specified number;

8 (c) setting as eligible for service each occupied FTC queue based on a FTC scheduling
9 algorithm; and

10 (d) selecting for service an eligible FTC queue based on a corresponding sub-priority of
11 each eligible FTC queue, wherein:

12 each FTC queue is assigned a sub-priority based on a service level of a connection associated
13 with enqueued cells;

14 when the super-occupied queue is serviced, the number of cells dequeued is based on a burst
15 size; and

16 at least one of the plurality of queues is associated with a second traffic class (STC), step (a)
17 further comprises the step of identifying each STC queue having at least one enqueued cell as an
18 occupied STC queue, and the method further comprises the steps of:
19 (e) setting as eligible for service each occupied STC queue based on a STC scheduling
20 algorithm, wherein, for step (e), the STC scheduling algorithm is a weighted round robin scheduling
21 algorithm;
22 (f) selecting for service an eligible STC queue based on the corresponding priority of the
23 eligible STC queue; and
24 (g) selecting one of the FTC queue selected for service, if present, and the STC queue
25 selected for service, if present.

1 46. (new) A scheduler for selecting one of a plurality of queues for service, at least one of
2 the plurality of queues associated with a first traffic class (FTC), the scheduler comprising:
3 an occupancy processor configured to identify each FTC queue having at least one enqueued cell
4 as an occupied FTC queue, wherein:

- 5 1) at least one FTC queue may be provisioned for burst scheduling of multiple cells
6 when serviced, and
- 7 2) an occupied FTC queue provisioned for burst scheduling is also identified as a
8 super-occupied FTC queue when a number of cells enqueued is greater than a provisioned number;
9 a FTC eligibility processor configured to set as eligible for service each occupied FTC queue
10 based on a FTC scheduling algorithm; and
- 11 a FTC queue selector configured to select for service an eligible FTC queue, wherein:
12 each FTC queue is assigned a sub-priority based on a service level of a connection
13 associated with enqueued cells;
- 14 the FTC queue selector selects an eligible FTC queue based on the corresponding
15 sub-priority of each eligible FTC queue;
- 16 when the super-occupied FTC queue is serviced, the number of cells dequeued is based
17 on a burst size; and
- 18 for each sub-priority, the FTC queue selector comprises a pointer addressing the FTC
19 queue having the highest priority value within those eligible FTC queues assigned to the sub-priority, the
20 priority of an eligible FTC queue based on the order in which the eligible FTC queue is set as eligible by
21 the FTC eligibility processor.

1 47. (new) The invention of claim 46, wherein each sub-priority is ranked, and the FTC
2 queue selector selects the FTC queue within a sub-queue based on the pointer, and selects for service the
3 selected FTC queue from among the sub-queues based on the corresponding sub-queue's rank.

1 48. (new) The invention of claim 46, wherein, when the FTC queue selector selects a given
2 FTC queue for service, a bid is generated and the given FTC queue is serviced when the bid is granted.

1 49. (new) A scheduler for selecting one of a plurality of queues for service, at least one of
2 the plurality of queues associated with a first traffic class (FTC), the scheduler comprising:
3 an occupancy processor configured to identify each FTC queue having at least one enqueued cell
4 as an occupied FTC queue, wherein:
5 1) at least one FTC queue may be provisioned for burst scheduling of multiple cells
6 when serviced, and- 7 2) an occupied FTC queue provisioned for burst scheduling is also identified as a
8 super-occupied FTC queue when a number of cells enqueued is greater than a provisioned number;
9 a FTC eligibility processor configured to set as eligible for service each occupied FTC queue
10 based on a FTC scheduling algorithm; and

11 a FTC queue selector configured to select for service an eligible FTC queue, wherein:
12 each FTC queue is assigned a sub-priority based on a service level of a connection
13 associated with enqueued cells;
14 the FTC queue selector selects an eligible FTC queue based on the corresponding
15 sub-priority of each eligible FTC queue;
16 when the super-occupied FTC queue is serviced, the number of cells dequeued is based
17 on a burst size;
18 at least one of the plurality of queues is associated with a second traffic class (STC);
19 the occupancy processor is configured to identify each STC queue having at least one
20 enqueued cell as an occupied STC queue; and
21 the scheduler further comprises:
22 a STC eligibility processor configured to set as eligible for service each
23 occupied STC queue based on a STC scheduling algorithm;
24 the STC scheduling algorithm is a weighted round robin scheduling algorithm;
25 a STC queue selector configured to select for service an eligible STC queue
26 based on the corresponding priority of the eligible STC queue; and
27 a scheduler /arbiter controller configured to select one of the FTC queue selected
28 for service, if present, and the STC queue selected for service, if present.